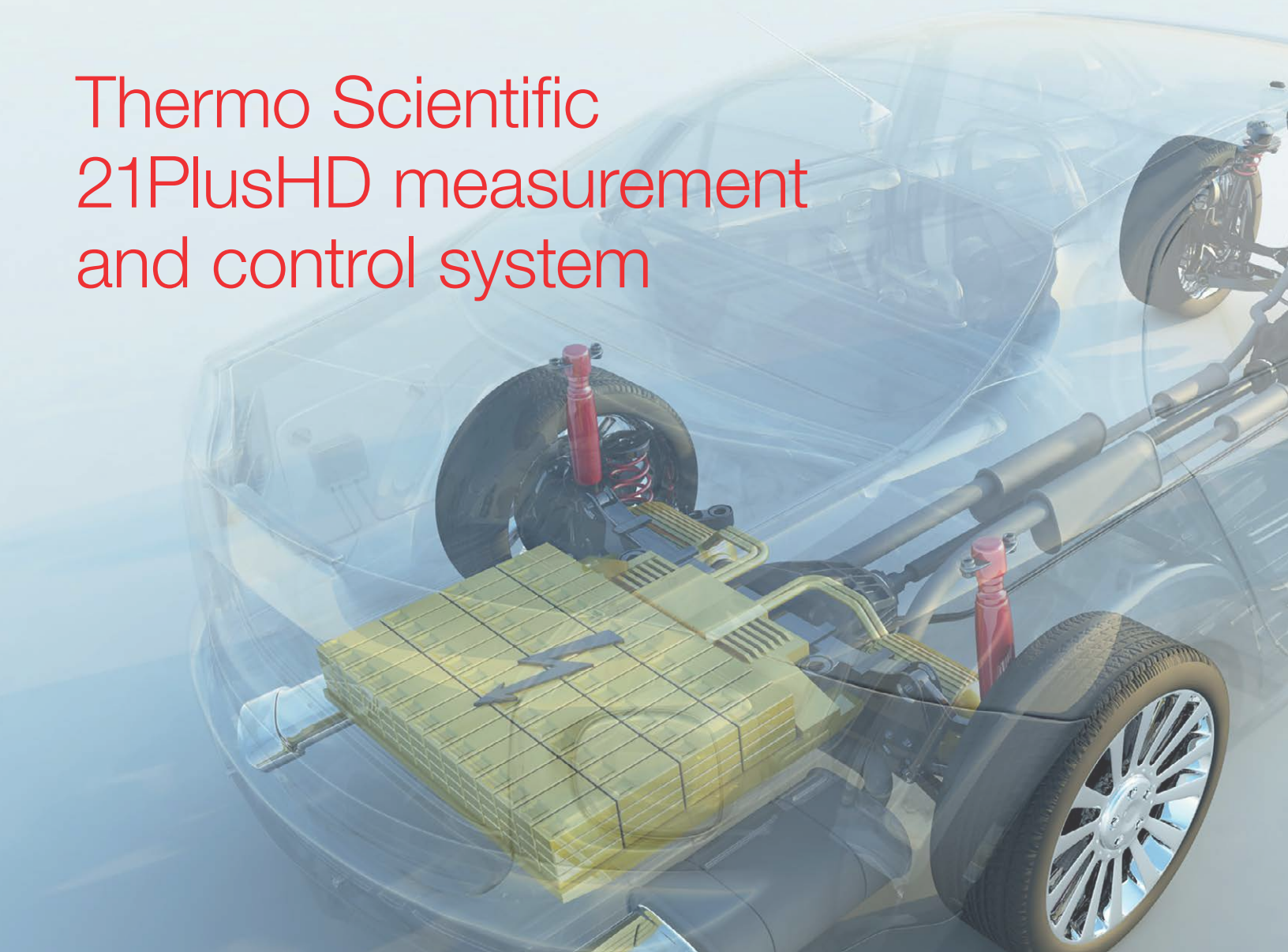


Thermo Scientific 21PlusHD measurement and control system



Solutions for lithium-ion battery

Thermo Scientific 21PlusHD measurement and control system

Solutions for lithium-ion battery

Application overview

From small hand-held electronics to medium-sized electric vehicles such as cars, buses and trucks, to larger marine vessels and smart-grid energy storage systems, lithium-ion battery technology is changing our lives. Critical to the advancement of the battery is the emergence of higher quality separator film, the coating of separator film for higher efficiency, and the coating of the anode and cathode. Discover how the Thermo Scientific™ 21PlusHD measurement and control system from Thermo Fisher Scientific is helping the industry improve the quality, consistency and productivity of lithium-ion batteries.

Separator film

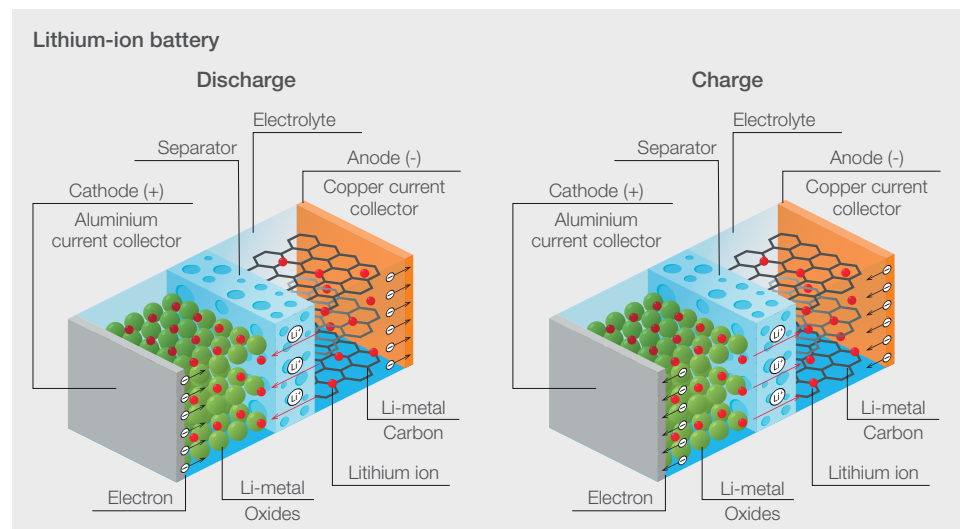
Separator film is one of the key components of a lithium-ion battery. It is a thin but permeable layer of film used to separate the anode from the cathode and prevent short-circuiting while facilitating the flow of charged ions. Separator films are produced either by a dry or wet process to create the required micro porous structure. Therefore, consistent thickness of the film and homogenous distribution of the pores are necessary to optimize the performance and life of the battery. Additionally, separator film can be coated with ceramic or another material to improve efficiency.

Anode and cathode coating

Continuous or patch coating on an aluminum substrate for the cathode or on a copper substrate for the anode is an expensive and challenging operation. Uneven coating of the cathode or anode will result in poor construction of the battery. Even worse, it could create a hotspot lowering the efficiency of the battery, shortening its lifespan, increasing charge time and the risk of thermal runaway. Furthermore, coated products are not recoverable. Therefore, an accurate measurement of the coat weight on both sides of the substrate is paramount to controlling and perfecting the process, and improving yield and quality.

Anode and cathode calendaring (press line)

After the electrode coating is controlled to the proper coat weight, the electrode material is calendered for homogeneous thickness and particle size. Pressing the ingredients of a composite electrode improves electrical contact and adhesiveness, and assures the desired geometric and electrochemical characteristics. Proper coating thickness measurement and calender control is critical not only to avoid excessive calender pressing, which could destroy the porous nature of the electrode, but also to provide final dimensional accuracy and essential product attributes in this important process step.



Direct thickness measurement of separator film

Leveraging over 20 years of experience with on-line infrared measurement technology, the Thermo Scientific™ PROSIS™ thickness sensor is a new breed of advanced non-nuclear measurement technology and in combination with the 21PlusHD measurement and control system, is the ideal solution for measuring the thickness of separator film. Designed to provide the highest accuracy and measurement resolution possible, the PROSIS thickness sensor has a wider spectral coverage range that allows it to measure more materials than ever before. Unlike any other IR sensing technology available on the market, the PROSIS thickness sensor analyzes the full spectral response of the separator film to infrared IR energy and provides

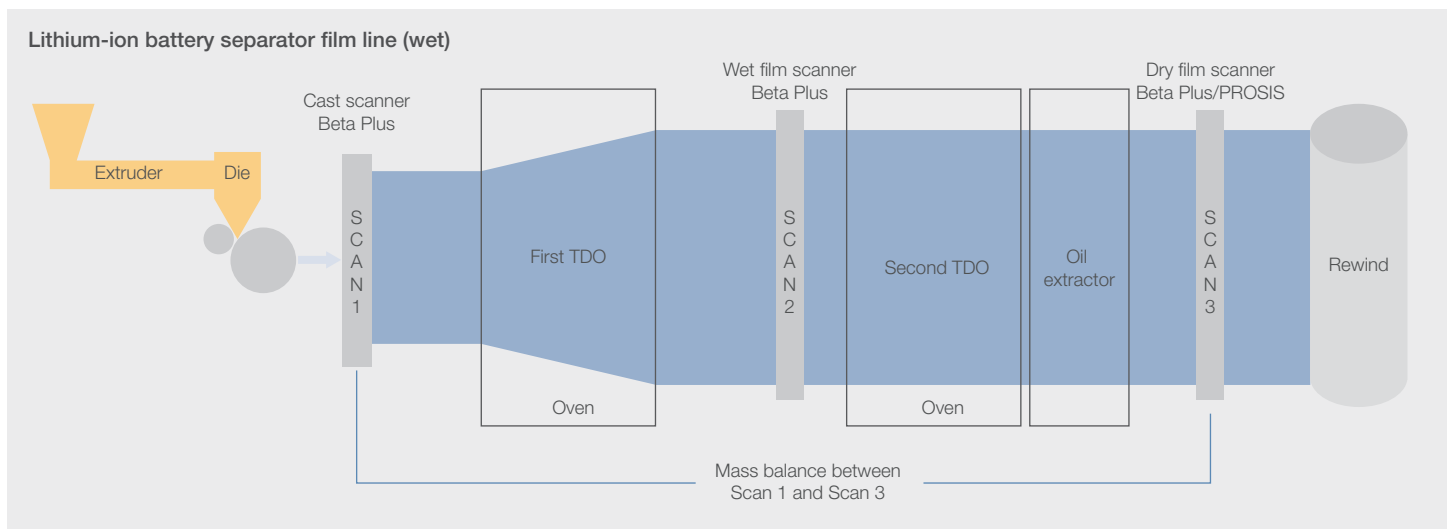
the most accurate thickness measurement possible.

Coupled with options like Automatic Profile Control (APC) and Machine Direction Control (MD), the 21PlusHD measurement and control system will provide measurable return on investment through higher quality production, increased yield and decreased scrap.

The Thermo Scientific™ Beta Plus basis weight sensor can also be used for the measurement and control of separator film and is especially suitable for film coated with ceramics or other similar inorganic material.

Applications

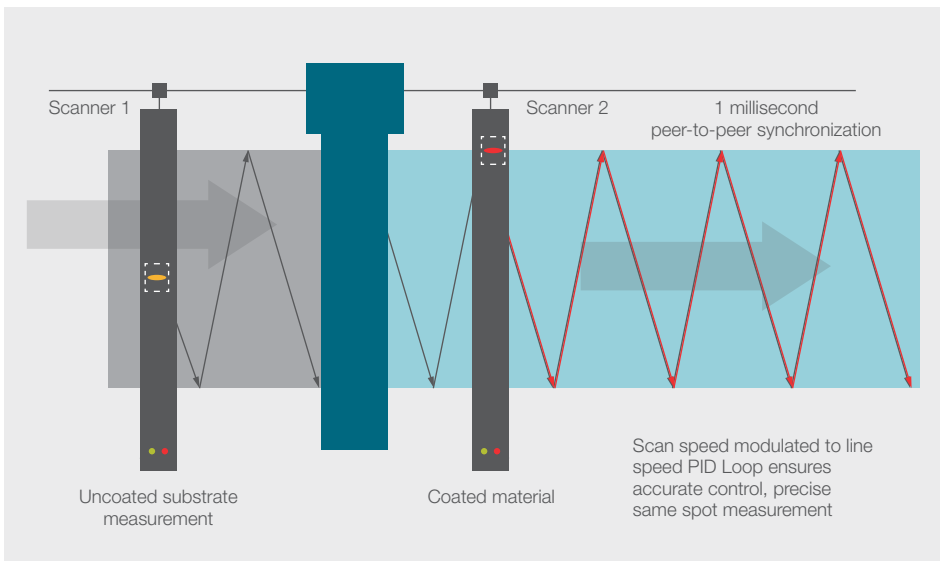
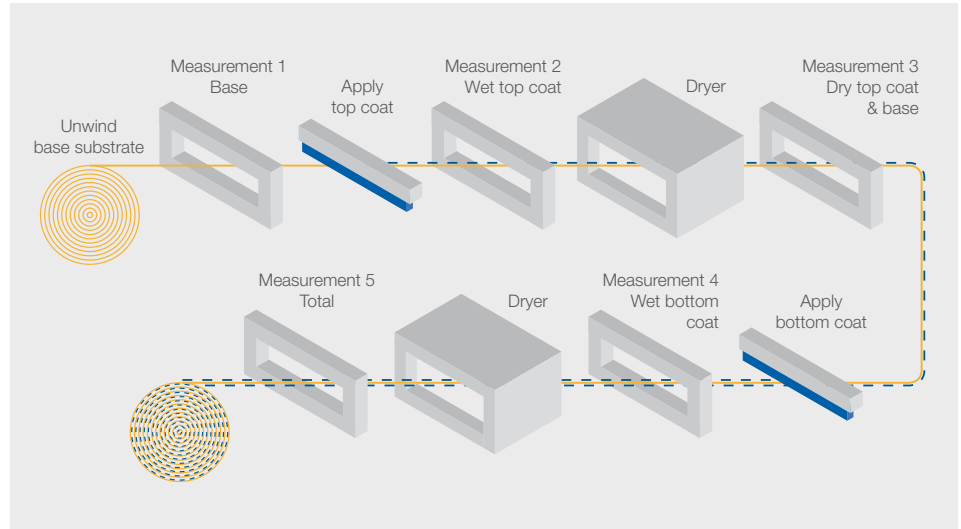
- Film thickness
- Wet and dry weight
- Oil
- Density
- Integrated mass balance die mapping
- Coated and uncoated films



Coat weight measurement of anode and cathode

Anode / cathode coating line

The Beta Plus basis weight sensor is the ideal sensing technology for measuring the coatings on the cathode and anode. The Beta Plus basis weight sensor features exceptionally high signal with extremely low noise and a unique isotope geometry that results in the most accurate coating weight measurement possible and highest edge resolution. With a dynamic scanning repeatability of $\pm 0.025\%$ (Krypton-85 model), the performance of the Beta Plus basis weight sensor in combination with the 21PlusHD measurement and control system is unparalleled.

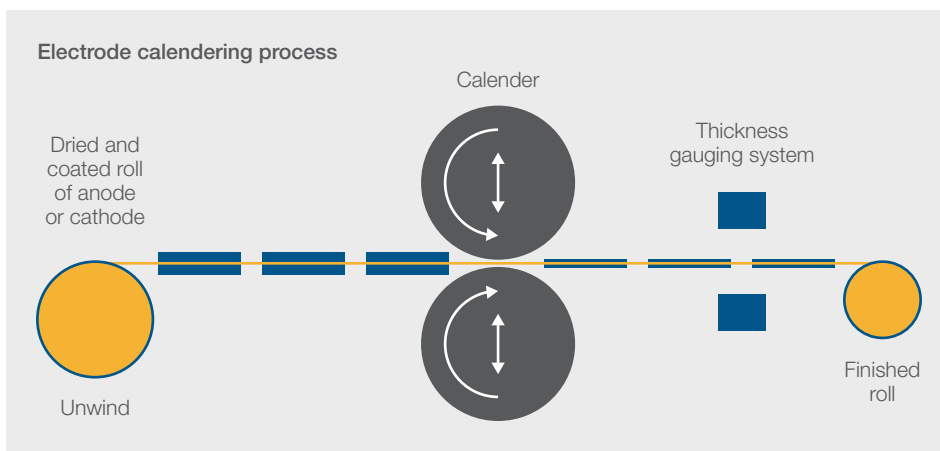
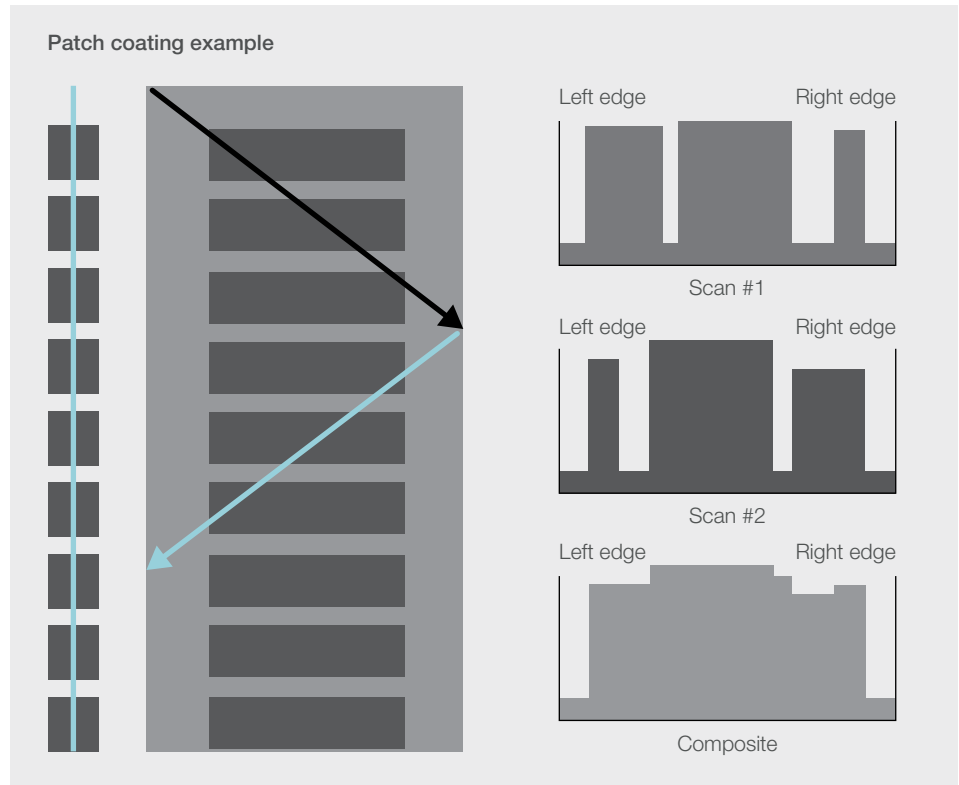


Thermo Scientific Exactrax same spot measurement

Combining the Thermo Scientific[™] Exactrax[™] same spot measurement synchronization with the lithium-ion battery coating application package available on the 21PlusHD measurement and control system, it is possible to intelligently measure the correct coat weight by recognizing both coated and uncoated sections of the anode or cathode. This will ensure high quality and in-spec production and help reduce the risk of non-uniformity and other downstream battery production issues.

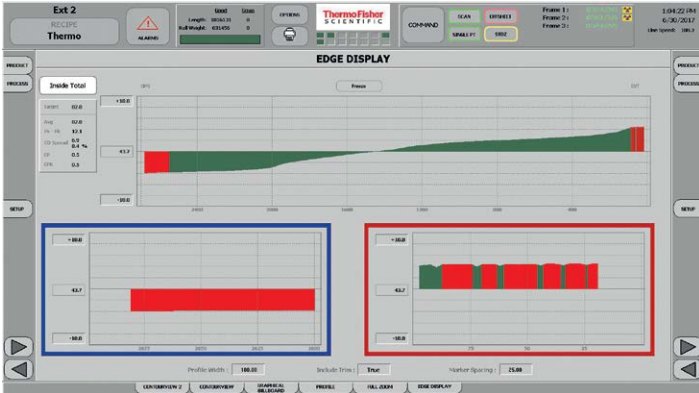
Thickness measurement of anode and cathode

The battery calendaring application package completes the Thermo Scientific suite of solutions for lithium-ion battery. It uses a dual displacement laser C-Frame to accurately measure, control, and provide key dimensions of calendared electrode materials. This robust solution is available for electrode thicknesses from 0.2 to 20mm, with an accuracy of $\pm 1.0 \mu\text{m}$. Its high-speed scanning capability maximizes measurement coverage in patch and strip coating applications, while its hardened design can withstand temperatures of up to 50°C with an available cooling option.

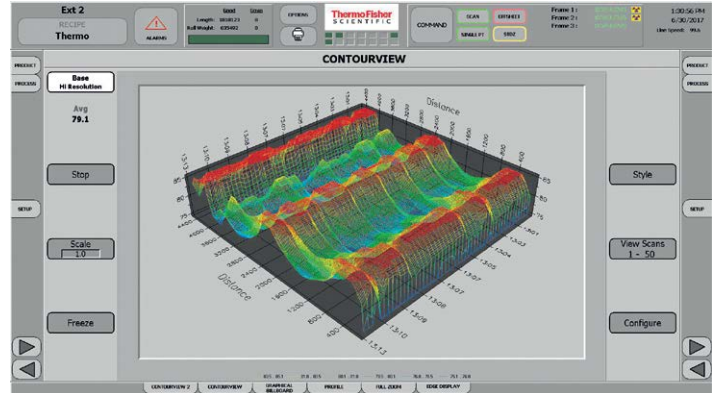


The combination of advanced control strategies, analytics and reporting capabilities (roll, shift, and production reports, Contourview 3D profile displays, zoom displays, SPC/QC control charts, and defect mapping), make the 21PlusHD measurement and control system a high performance platform, specifically designed to increase the quality, consistency and performance efficiency of lithium-ion battery separator film, electrode coating, and electrode calendaring production lines.

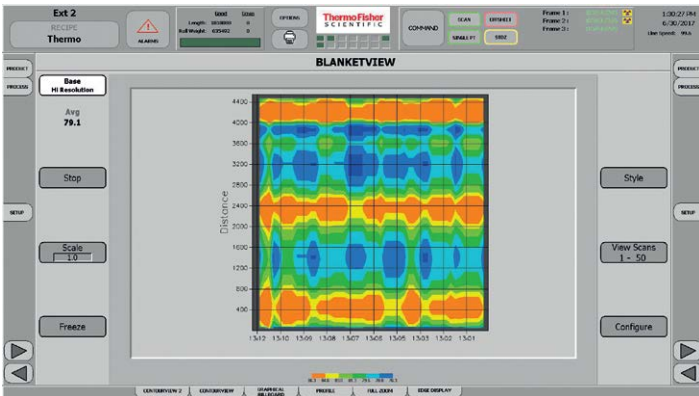
21PlusHD measurement and control system example displays



Profile with Edge Zoom



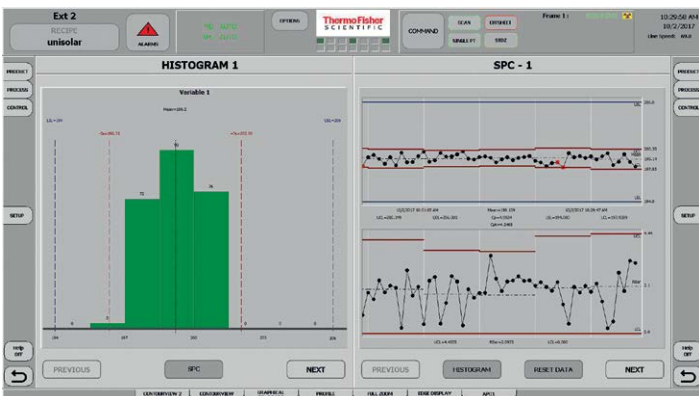
3D ContourView



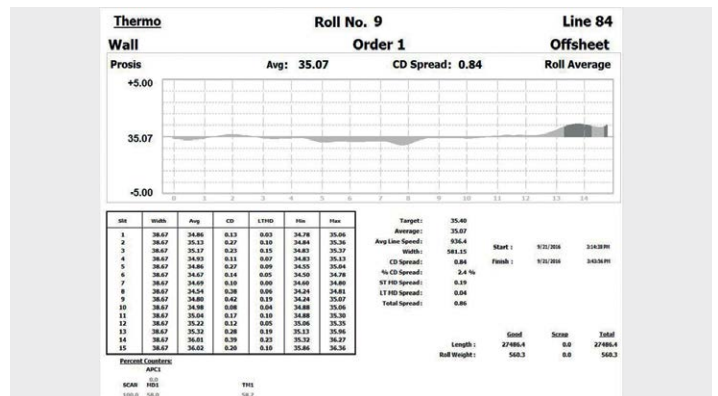
2D HeatMap



Slit Roll Summary



SPC Control Charts



Roll Report

Support you can depend on

Thermo Scientific products are supported by our extensive network of qualified application engineers who will work closely with you to understand and evaluate your specific production parameters. Our experts will help you choose the right instruments for your application, then keep them performing to spec. Their goal is to optimize your process today, and also lay the foundation for easy upgrades in the future.

Product maintenance

Our comprehensive service offering is based on corrective and preventative maintenance that not only reduces downtime, but also helps you improve your process. We offer multiple levels of support agreements, with varying degrees of access and response, including:

- System commissioning
- System calibration
- Preventative maintenance
- On-site repair
- Depot repair

Some options feature complete cost predictability, with all travel, labor, spare parts, and consumables included.

Education and training

We offer multiple training options to help you increase productivity by optimizing the use of your instruments and expanding the skills of your operators. You can receive hands-on instruction in your plant or at one of our training facilities in the USA, Europe and Asia. Our range of courses covers:

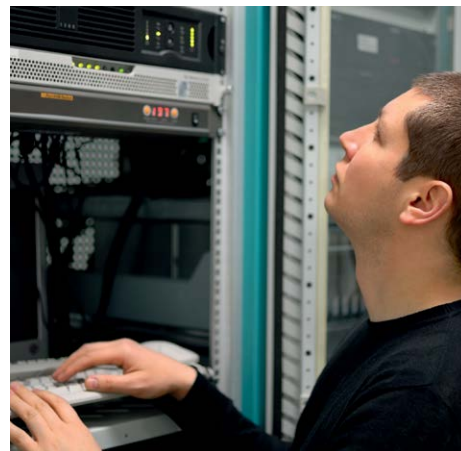
- Basic operation
- Calibration
- Routine maintenance
- Troubleshooting
- Certification

We will also work with you to develop a custom program that meets your specific training objectives, often incorporating your own operating procedures.

Professional services

Our certified engineers are available to review your process, perform benefit analysis and recommend improvements to help you meet your best-practice goals. We will develop an implementation plan that integrates all Thermo Scientific systems, as well as third-party components including:

- System layout and connectivity
- Software implementation, configuration and support
- Site modifications



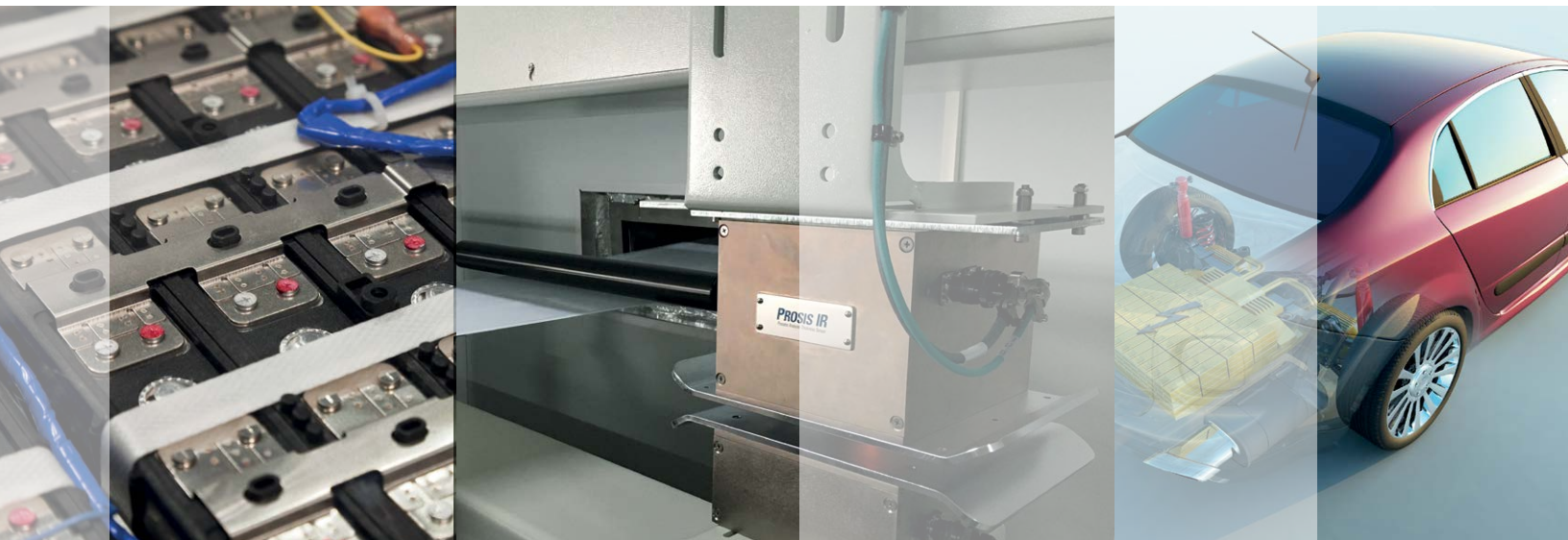
You can rely on us to manage the entire installation and start-up if you choose, including serving as a liaison with licensing agencies where necessary.

Parts and upgrades

Our spare parts are designed specifically for your Thermo Scientific system, and we make it easy for you to secure high-quality, low-cost replacements by maintaining offices around the world that respond quickly to your phone or online requests. You can also extend the lifetime of your older instruments with our add-on system enhancement and retrofit packages, which adapt your instruments for new uses and eliminate the time and cost to retrain operators on new equipment.

21PlusHD measurement and control system

Solutions for lithium-ion battery



ISO REGISTERED COMPANY
9001
Thermo Fisher Scientific,
Erlangen, Germany is ISO Certified.

USA

22 Alpha Road
Chelmsford, MA 01824
800 366 2533

Germany

Frauenauracher Str. 96
91056 Erlangen
+49 (0) 9131 998 0

Brazil

Rúa Eugênio de Medeiros,
303, 11th floor
CEP: 05425-000 São Paulo – SP
+55 11 2730 3261

China

Building 6, No. 27 Xin Jinqiao
Pudong, Shanghai 210206
+86 (0) 21 6865 4588

Japan

3-9C Building, Moriya-cho,
Kamagwa-Ku, Yokohama 221-022
+81 45 453 9188

India

101/102 Pride Portal
Shivaji Housing Society
Village Bhamburda, Pune 411016
+91 20 6626 7000

Korea

11 floor, Suseo Office Building
281, Gwangpyeong-ro,
Gangnam-gu, Seoul, 06349
+86 (0) 2 2023 0600

Australia

18 Butler Boulevard
Burbridge Business Park
Adelaide, 5950
+61 (08) 8208 8200

Find out more at thermofisher.com/gauging

© 2013 – 2020 Thermo Fisher Scientific Inc. All rights reserved. All trademarks are the property of Thermo Fisher Scientific Inc. and its subsidiaries unless otherwise specified. Results may vary under different operating conditions. Specifications, terms and pricing are subject to change. Not all products are available in all countries. Please contact your local sales representative for details.
CAD.6720.02.20